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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/388,063	08/30/1999	VISHNU AGARWAL	MI22-1196	3351
21567	7590	12/16/2003	EXAMINER	
WELLS ST. JOHN P.S. 601 W. FIRST AVENUE, SUITE 1300 SPOKANE, WA 99201			FENTY, JESSE A	
			ART UNIT	PAPER NUMBER
			2815	

DATE MAILED: 12/16/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/388,063

Applicant(s)

AGARWAL ET AL.

Examiner

Jesse A. Fenty

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 September 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 5-37 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 5-37 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 August 1999 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 37. 6) ☐ Other:

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DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114.

Applicant's submission filed on 09/05/03 has been entered.

Allowable Subject Matter

1. The indicated allowability of claims WHATEVER are withdrawn in view of the newly discovered reference(s) to Ueda et al. (U.S. Patent No. 6,285,051 B1) and Tsu et al. (U.S. Patent No. 5,635,741). Rejections based on the newly cited reference(s) follow.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the capacitor being formed over the substrate and devoid of intermediate layers between one of the first and second conductive electrodes and the substrate, as claimed in claims 33-37 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

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A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 5, 7, 9, 12, 13, 15, 18, 21 and 24-37 are rejected under 35 U.S.C. 102(b) as being anticipated by Tsu et al. (U.S. Patent No. 5,635,741).

In re claim 5, Tsu (Fig. 2) discloses a semiconductor device, comprising:

First (18) and second (26) conductive electrodes having a high k capacitor dielectric region (24) positioned therebetween, the high k capacitor dielectric region comprising a layer of metal oxide (BST) having multiple different metals (Ba, Sr, Ti) bonded with oxygen, one of the metals when bonded with oxygen having a first current leakage potential (32 or 36), another of the metals when bonded with oxygen having a second current leakage potential (34) which is greater than the first current leakage potential, the layer comprising at least one portion having a greater concentration of the one metal bonded with oxygen which is more proximate at least one of the first and second electrodes than another portion more proximate a center of the layer (column 6, lines 2-15).

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In re claim 7, Tsu discloses the device of claim 5, wherein the layer comprises portions having a greater concentration of the one metal bonded with oxygen more proximate both the first and second electrodes than the another portion more proximate the center of the layer. Note that (column 6, lines 2-15), the Ba-Sr ratio may be different in layer (32/36) than in layer (34). Therefore, in the layers (32/36) closer to the electrodes, either one of Ba or Sr will have a higher concentration than in the layer (34).

In re claim 9, Tsu discloses the device of claim 5, wherein the layer comprises portions having a greater concentration of the one metal bonded with oxygen more proximate both the first and second electrodes than the another portion more proximate the center of the layer (as in claim 7), said greater concentration portion respectively contacting the first (18) and second (26) electrodes.

In re claim 12, Tsu (Fig. 2) discloses a semiconductor device, comprising:

First (18) and second (26) conductive electrodes having a high k capacitor dielectric region (24) positioned therebetween, the high k capacitor dielectric region comprising a layer of metal oxide (BST) having multiple different metals (Ba, Sr, Ti) bonded with oxygen, one of the metals when bonded with oxygen producing a first material having a first current leakage potential, absence of the one metal (change in ratio between Ba and Sr; column 6, lines 9-15) in the oxide creating a vacancy (a lessening of one of the elements) and a second material having a second current leakage potential which is greater than the first current leakage potential, the layer comprising at least one portion having a greater concentration of the first material which is more proximate at least one of the first and second electrodes than another portion more proximate a

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center of the layer. In the layers (32/36) closer to the electrodes, either one of Ba or Sr will have a higher concentration than in the layer (34).

In re claim 13, Tsu discloses the device of claim 12, wherein the layer comprises portions (32/36) having a greater concentration of the first material more proximate both the first and second electrodes than the another portion (34) more proximate the center of the layer.

In re claim 15, Tsu discloses the device of claim 12, wherein the layer comprises portions having a greater concentration of the first material more proximate both the first and second electrodes than the another portion more proximate a center of the layer, said greater concentration portions respectively contacting the first and second electrodes.

In re claim 18, Tsu (Fig. 2) discloses a semiconductor device, comprising:

First (18) and second (26) conductive electrodes having a high k capacitor dielectric region (1) positioned therebetween, the high k capacitor dielectric region comprising a layer of metal oxide (BST) having multiple different metals (Ba, Sr, Ti) bonded with oxygen, one of the metals (Sr) when bonded with oxygen having a first dielectric constant, another of the metals (Ba) when bonded with oxygen having a second dielectric constant (column 6, lines 13-14) which is less than the first dielectric constant (of layer 34), the layer comprising at least one portion having a greater concentration of the one metal bonded with oxygen more proximate a center of the layer than another portion more proximate either of the first and second electrodes.

In re claim 21, Tsu discloses the device of claim 18, wherein the layer comprise portions having a greater concentration of the another metal bonded with oxygen more proximate both the first and second electrodes than the one portion more proximate the center of the layer, said greater concentration portions respectively contacting the first and second electrodes.

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In re claim 24, Tsu discloses the device of claim 18, wherein the metal oxide with multiple different metals bonded with oxygen comprises barium strontium titanate (BST), and the one metal comprises at least one of barium and strontium.

In re claim 25, Tsu (Fig. 2) discloses a semiconductor device, comprising:

First and second conductive electrodes having a high k capacitor dielectric region positioned therebetween, the high k capacitor dielectric region comprising a layer of metal oxide having multiple different metals bonded with oxygen, one of the metals when bonded with oxygen producing a first material (34) having a first dielectric constant, absence of the one metal (the variation of the Sr-Ba ratio) in the oxide creating a vacancy and a second material (32/36) having a second dielectric constant which is less than the first dielectric constant (column 6, lines 13-14), the layer comprising at least on portion having a greater concentration of the first material which is more proximate a center of the layer than another portion more proximate either of the first and second electrodes. Note that either Sr or Ba will be greater in the layer (34), which is more proximate the center when the Sr-Ba ratio is changed. Thus, the claim is anticipated.

In re claim 26, Tsu discloses the device of claim 25, wherein the layer comprises portions having a greater concentration of the first material more proximate both the first and second electrodes than the another portion more proximate a center of the layer.

In re claim 27, Tsu discloses the device of claim 25, wherein the another portion contacts the one electrode.

In re claim 28, Tsu discloses the device of claim 25, wherein the layer comprises portions having a grater concentration of the another material more proximate both the first and second

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electrodes than the one portion more proximate a center of the layer (column 6, lines 4-14), said greater concentration portions respectively contacting the first and second electrodes.

In re claim 29, Tsu discloses the device of claim 25, wherein the capacitor dielectric region consists essentially of the layer.

In re claim 30, Tsu discloses the device of claim 25, wherein the metal oxide with multiple different metals bonded with oxygen comprises a titanate.

In re claim 31, Tsu discloses the device of claim 25, wherein the metal oxide with multiple different metals bonded with oxygen comprises BST, and the one metal comprises at least one of barium and strontium.

In re claim 32, Tsu (Fig. 2) discloses a semiconductor device, comprising:

First (18) and second (266) conductive electrodes having a high k charge storage dielectric region (24) positioned therebetween, the high k charge storage dielectric region comprising a layer of metal oxide having multiple different metals (Ba, Sr, Ti) bonded with oxygen, the layer having varying stoichiometry across its thickness (column 6, lines 2-16)), the layer comprising an inner region (32), a middle region (34), and an outer region (36), the middle region having a different stoichiometry than both the inner and outer region (column 6, lines 9-12), wherein the electrodes comprise material of at least titanium nitride (column 6, lines 30-34).

In re claims 33-37, as best understood, Tsu discloses the devices of claims 5, 12, 18, 25 and 32, wherein the capacitor is formed over a substrate (12) and devoid of intermediate layers between one of the first and second electrodes and the substrate.

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(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. Claims 5, 6, 8, 10-12, 14, 16-20, 22 and 23 are rejected under 35 U.S.C. 102(e) as being anticipated by Ueda et al. (U.S. Patent No. 6,285,051 B1).

In re claim 5, Ueda (Figs. 1-4) discloses a semiconductor device, comprising:

First (6) and second (15) conductive electrodes having a high k capacitor dielectric region (1) positioned therebetween, the high k capacitor dielectric region comprising a layer of metal oxide (BST) having multiple different metals (Ba, Sr, Ti) bonded with oxygen, one of the metals (Ti) when bonded with oxygen having a first current leakage potential (layer 5, low-leakage-current layer), another of the metals (Ba) when bonded with oxygen having a second current leakage potential (layer 3) which is greater than the first current leakage potential, the layer (1) comprising at least one portion (5) having a greater concentration of the one metal bonded with oxygen which is more proximate at least one of the first and second electrodes than another portion more proximate a center of the layer (column 5, lines 18-32).

In re claim 6, Ueda discloses the device of claim 5, wherein the another portion has a greater concentration of the another of the metals bonded with oxygen than the one portion.

Note that, Ueda discloses (column 7, lines 49-63) that the content of the Ti in layer (5) may vary from a majority to a minority, thereby being less Ti than in the layer (3).

In re claim 8, Ueda discloses the device of claim 5, wherein the at least one portion contacts the one electrode (15).

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In re claim 10, Ueda discloses the device of claim 5, wherein the metal oxide with multiple different metals bonded with oxygen comprises a titanate (BST), and the one metal (6) comprises titanium (column 5, lines 35-38).

In re claim 11, Ueda discloses the device of claim 5, wherein the capacitor dielectric region consists essentially of the layer.

In re claim 12, Ueda discloses a semiconductor device, comprising:

First (6) and second (15) conductive electrodes having a high k capacitor dielectric region (1) positioned therebetween, the high k capacitor dielectric region comprising a layer of metal oxide (BST) having multiple different metals (Ba, Sr, Ti) bonded with oxygen, one of the metals (Ti) when bonded with oxygen producing a first material having a first current leakage potential, absence of the one metal in the oxide creating a vacancy and a second material having a second current leakage potential which is greater than the first current leakage potential (column 5, lines 60-66), the layer (either 3 or 5) comprising at least one portion having a greater concentration of the first material which is more proximate at least one of the first and second electrodes than another portion more proximate a center of the layer.

In re claim 14, Ueda discloses the device of claim 12, wherein the at least one portion contacts one electrode.

In re claim 16, Ueda discloses the device of claim 12, wherein the metal oxide with multiple different metals bonded with oxygen comprises a titanate (BST), and the one metal comprises titanium (column 5, lines 35-38).

In re claim 17, Ueda discloses the device of claim 12, wherein the dielectric region consists essentially of the layer (1).

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In re claim 18, Ueda (Figs. 1-4) discloses a semiconductor device, comprising:

First (6) and second (15) conductive electrodes having a high k capacitor dielectric region (1) positioned therebetween, the high k capacitor dielectric region comprising a layer of metal oxide (BST) having multiple different metals (Ba, Sr, Ti) bonded with oxygen, one of the metals (Ti) when bonded with oxygen having a first dielectric constant, another of the metals (Ba) when bonded with oxygen having a second dielectric constant which is less than the first dielectric constant, the layer comprising at least one portion having a greater concentration of the one metal bonded with oxygen more proximate a center of the layer than another portion more proximate either of the first and second electrodes.

Ueda discloses "as the content of Ti increases, the relative dielectric constant decreases drastically," (column 6, lines 26-28) and that the content of Ti in layer (5) may vary from a majority to a minority (column 7, lines 49-63). When the Ti is less in layer (5) than in layer (3), layer (3) will be more proximate a center of the layer.

In re claim 19, Ueda discloses the device of claim 18, wherein the another portion contacts one of the first and second electrodes.

In re claim 20, Ueda discloses the device of claim 18, wherein the another portion has a greater concentration of the another of the metals boded with oxygen than the one portion.

In re claim 22, Ueda discloses the device of claim 18, wherein the capacitor dielectric region consists essentially of the layer (1).

In re claim 23, Ueda discloses the device of claim 18, wherein the metal oxide with multiple different metals bonded with oxygen comprises a titanate (BST), and the one metal (6) comprises titanium (column 5, lines 35-38).

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Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Arita et al. (U.S. Patent No. 6,236,076 B1) in view of Ueda et al. (as above).

In re claim 32, Arita (Figs. 9, 19) discloses a semiconductor device, comprising:

First (30) and second (816) conductive electrodes having a high k charge storage dielectric region (170) positioned therebetween, the high k charge storage dielectric region comprising a layer of metal oxide having multiple different metals bonded with oxygen, the layer having varying stoichiometry across its thickness (column 14, lines 9-30), the layer comprising an inner region (174), a middle region (176), and an outer region (178), the middle region having a different stoichiometry than both the inner and outer region. Arita does not expressly disclose the lower electrode comprising titanium nitride. Ueda (column 5, lines 35-38) discloses a lower electrode comprising titanium nitride. It would have been obvious for one skilled in the art at the time of the invention to use a buffer layer of titanium nitride as disclosed by Ueda in the electrode structure of Arita for the purpose, for example, of creating a buffer region to better isolate device regions.

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Conclusion

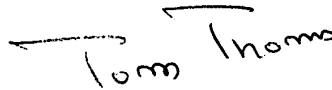
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jesse A. Fenty whose telephone number is 703-308-8137. The examiner can normally be reached on 5/4-9 1st Fri. Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Jesse A. Fenty
Examiner
Art Unit 2815

JAF

A handwritten signature in cursive script that reads "Tom Thomas".

TOM THOMAS
SUPERVISORY PATENT EXAMINER